LTR	REVISION	DATE	APPROVAL
A	SEE DCN-64001	09-05-80	R. T.
B	CHANGED PARA 3.2.15 (P,9) LEAD AZIDE QUANTITY FROM 150 mg. To 188 mg. EACH INCREMENT.	06-02-81	R. TAEUBER J. SMITH (mat'l.)
C	REPLACED FIGURE 1 (page 24) SEE DCN 68306	08-24-81 08-19-81	D. WEARY S. GLORIOSO
D	CHANGED Para 3.2.11 MADE WELD ANY APPROVED PROCESS	10-01-81 10-05-81	D. WEARY J. SMITH
E	Page 12 Changed Para 4.4.2 From -260 (+20,-5) °F to -65 (+\-5) °F. Page 14 Changed Para 4.4.8 From -260 (+20,-5) °F to -65 (+\-5) °F. Dent Block Penetration from TBD to 0.030 min. Para 4.4.9 Dent Block Penetration from TBD to 0.020 min. Page 19, Para 4.5.10 J from EP4 to EP2 Page 24 *note -added Paragraph 3.9.3 of JSC 08060, Rev D	06-15-84	CECIL GIBSON G. K. HORIUCHI
F	Revised Extensively	07-24-89	W. Hoffman G. Miller J. Bennett G. Bulcken B. Wittchens
G	Revised Extensively	03-08-91	J. Johnson W. Hoffman G. Miller J. Bennett E. Johnson B. Wittchens
H	Added NSI O-ring number, para. 3.1.4 Changed Table V, para. 5.2.2.3; test quantities Deleted page 24	06-08-93	Engr. App J. Johnson 9/30/93 Pyro SSM William Hoffman 9/30/93 Stress Jim McMahon 9/30/93 Mat'l JE Bennett 9-30-93 Q.E. For E. Johnson 9-30-93 Auth. B. Wittchens 9/30/93

Original Document signed by, Mike Steinthal 9/12/80; L. James Price 6/16/80; Ralph J. Taeuber 7/11/80; and (Mat'l) J. W. Smith 7/14/80.

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SIGNATURES	DATE
Mike Steinthal	9/80
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AUTH R. Taeuber	8/80

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LYNDON B. JOHNSON SPACE CENTER · HOUSTON, TEXAS

Design and Performance Specification for the NASA Standard Detonator (NSD Flight P/N SEB26100094)

CODE IDENT NO.	SIZE	DWG NO.
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1.0 SCOPE

1.1 SCOPE OF SPECIFICATION

This specification covers the requirements for the design, performance, and test of an electrically initiated hot-wire detonator assembly (hereinafter referred to as the detonator) for use in operational spacecraft.

2.0 APPLICABLE DOCUMENTS

2.1 APPLICABILITY

The following documents form a part of this specification to the extent specified herein. When a conflict of requirements exists, the following order of precedence shall prevail:

a. NASA Standard Detonator (NSD) assembly, Dwg. SEB26100094

b. Documents referenced herein

2.1.1 Specifications

NASA

NHB 5300.4 (1D-2)	Safety, reliability, maintainability, and quality provisions for the Space Shuttle Program
NSTS 08060 Rev. G June 10, 1993	Space Shuttle System Pyrotechnic Specification
JSC 20431 March 1985	Neutron Radiography Specification

Military

MIL-H-6875 September 16, 1983	Heat Treatment of Steel, Process For
MIL-STD-6866 October 4, 1989	Inspection, liquid penetrant method of
MIL-L-3055C January 12,1993	Lead Azide
MIL-R-398C August 22, 1962	RDX
MIL-S-5002D November 30, 1989	Surface treatments and inorganic coatings for metal surfaces of weapons systems
MIL-S-7742D July 25, 1991	Screw threads standard, optimum selected series; general specification for

Federal

FED-STD-101C	Preservation, packaging, and packing materials; test procedures
FED-STD-595B	Colors
QQ-B-626D October 2, 1973	Brass, leaded and non-leaded, rod, shaped, forging and flat products with finished edges (bar and strip)
QQ-A-250/1E December 4, 1970	Aluminum alloy 1100, plate and sheet

2.1.2 Standards

NASA

JSCM 8080-103 April 1, 1991	Explosive Devices color coding requirements

Military

MIL-STD-130G October 11, 1988	Identification marking of U.S. Military Property
MIL-STD-970 October 1, 1990	Specification and Standards, order of precedence for the selection of
MIL-STD-331B December 1, 1989	Fuze and fuze components, Environmental and performance tests for
MIL-STD-453C December 27, 1984	Inspection, radiographic
MIL-STD-810E July 14, 1989	Environmental test methods
MS 33649C August 2, 1984	Boss, fluid connection internal straight thread

Industry Standards

SAE/AMS 5512H October 12, 1992	Steel, corrosion and heat resistance, sheet, plate and strip; Solution Heat Treated
SAE/AMS 3570D October 1, 1989	Flexible polyurethane foam open cells, medium flexibility 2.5 lb per cubic foot
SAE/AMS 5737L July 1, 1989	Bars, forging and tubing - 15 Cr-25.5 Ni-1.3 MO-2.l Ti-0.30 V Consumable Electrode Melted, 1650 Deg. F (899 °C) solution and Precipitation Heat Treated.

AMS 2759	Heat Treatment of Steel Parts
ASTM A370-92	Standard Test Methods and Definitions for Mechanical Testing of Steel Products

2.1.3 Selection Of Specifications and Standards

Unless otherwise specified, specifications and standards for materials, parts, and processes shall be selected using MIL-STD-970 as a guide, except that NASA documents, when suitable for the purpose, shall take precedence.

3.0 REQUIREMENTS

3.1 ITEM/INTERFACE DEFINITION

3.1.1 Fluid Contamination Prevention

To prevent contamination of the explosive material(s), with fluids, the suppliers applicable manufacturing procedures shall specify that each device shall be completely dry prior to loading and that no fluids are to be utilized for cleaning or weld preparation after addition of the explosive materials and prior to hermetic sealing. The procedures shall specify that the immediate area of explosive loading shall be free of such fluids as methanol, freon, solvents, or alcohol. In the event spillage of explosive material necessitates cleaning of the loading area with fluids, all parts must be removed from the area until after such cleaning is completed, the area is completely dry, and the fluids have been removed. Liquids shall not be used to clean a loaded unit prior to passing leak testing.

3.1.2 Item Definition

The NASA standard detonator (NSD) is the standard detonating device for the Space Shuttle and is provided as GFE to all users by JSC. The NSD consists of a NASA standard initiator (NSI) threaded into a housing containing a sensitive primary explosive train consisting of a lead azide column progressing into a final output charge of RDX. The output of the NSD produces a 0.040 inch minimum dent in a steel block.

3.1.2.1 Components

The detonator shall include the following components:

a. Body assembly (hereinafter referred to as "body").

b. Electrical hot-wire initiator (NSI P/N SEB26100001) consisting of body and electrical connector, bridgewire, and primary charge.

c. Explosive charge (lead azide)

d. Main charge (RDX)

e. All hardware required for complete assembly.

3.1.2.1.1 NSI Installation
Each lot of NSI's selected for NSD installation shall have successfully passed -420 °F Certification Tests prior to approval for use in NSDs.

3.1.3 Firing Mode

All NSD firings shall be conducted using the NASA supplied Initiator Firing Unit (IFU), SKD26100128, 1000 microfarad capacitor discharge system set at 30 vdc.

3.1.3.1 Firing test procedure

The firing test procedure shall be as follows:

a. Each firing circuit resistance shall be measured and recorded; the total firing circuit (including the NSI) shall not exceed 1.75 ohms.

b. Prior to firing any test series, a test of the firing setup shall be made by connecting the firing circuit to a one (1) ohm resister and performing a nominal firing. This test will verify proper oscilloscope triggering, firing cable setup and operation.

c. The SEB26100094 detonator shall be initiated in the capacitive discharge firing mode with applied impulse, current versus time for the firing recorded on an oscilloscope(s).

Note: Oscilloscope connections shall be used to assure that the adequacy of the firing current can be determined in the event of a failure to fire.

3.1.4 Government Furnished Property (GFP)

The following items will be furnished as GFP by NASA/JSC as required under his contract.

a. NASA Standard Initiators (NSI) P/N SEB26100001-216 and/or 217

b. Explosive material Lead Azide MIL-L-3055A TYPE I
RDX MIL-R-398C TYPE II CLASS 7

c. Initiator Firing Unit (IFU), SKD26100128

d. NSI "O"-RINGS, SDD26100095

3.1.5 Color Coding of Pyrotechnic Devices

The device shall be color coded as to status and usage (i. e., live or expended units for mock-up, etc.) in accordance with the following requirements:

a. Inert units: gloss red paint, color 11105 in accordance with FED-STD-595, with a clearly visible hole drilled through the output end into the chamber which normally contains the explosive charge.

b. Charged units not intended for flight, and rejected flight operational units: gloss blue paint, color 15102 in accordance with FED-STD-595. This category includes special purpose items such as: nonstandard charge units (off-loaded), test and development units, simulators, and charged training units.

c. Flight operational units; natural color of the body material (i.e., stainless steel, aluminum, etc.)

Nonstandard charge units (off-loaded) are defined as those units whose charge load is different from the charge load of operational units. Because of the various sizes and configurations of explosive devices, the location and extent of color coding cannot be defined herein. It is essential that the color coding be conspicuous but not obliterate identification markings such as part, lot, and serial numbers.

3.2 DESIGN REQUIREMENTS

3.2.1 Weight

The total weight of the detonator shall not exceed 1.5 ounces. Each detonator shall be weighed before and after loading of each pyrotechnic increment and these individual mix weights (as required on drawing SEB26100094) verified and recorded.

3.2.2 Initiator

The initiator specified on SEB26100094 shall be installed into the detonator body using 115 to 135 inch pounds of torque. When GFE faraday caps are supplied with the initiators, shorting plug or spring clip may be used for shorting during manufacture. The faraday caps shall be reinstalled prior to delivery of the detonators.

3.2.3 Detonator Output

The detonator shall have a minimum dent plate penetration of 0.040 inch for ambient and high temperature firings, 0.030 inch minimum for -265 °F firings and 0.020 inch minimum for cryogenic (-420 °F) firings at JSC per paragraph 5.1.9.

3.2.4 Hermetic Sealing

All detonators shall be hermetically sealed by fusion of metallic materials using an approved welding process.

3.2.5 Identification Of Product

The detonator shall be marked in accordance with the requirements of MIL-STD-130E, Figure 1 of this specification, and shall include the following information:

NASA Part Number: SEB26100094-XXX, Use appropriate Dash Number
NASA Serial Number/Lot Number:
Manufacturing Date:
Vendor I. D. Number:

3.2.6 Workmanship

The detonator, including all parts and accessories, shall be constructed and finished in a thoroughly workmanlike manner. All parts shall be free of burrs and sharp edges that might cause the detonator to malfunction or cause injury to personnel.

3.2.7 Restriction on Multiple Lot Use

Only one lot of each explosive material and component shall be used in the manufacture of a lot of detonators (reference paragraph 6.1.4). Multiple lots of NSIs may be used in a single lot of detonators.

3.2.8 Heat Treat and Welding

Control of heat treatment shall be in accordance with AMS 2759 or MIL-H-6875. All welding shall be in accordance with drawing specifications and performed to a written schedule.

3.2.9 Tensile Test, Detonator Body

The supplier shall conduct tensile tests on 3 coupons from the same material heat lot and exposed to the same heat treatment as the body material . Each test coupon shall be installed in a tensile strength tester and the following data shall be obtained from the test coupons and recorded on the lot acceptance data sheet. (Ref. AMS 5737H and ASTM A370)

a. Ultimate tension	140 KPSI minimum
b. 0.2 percent offset yield	95 KPSI minimum
c. Elongation	12 percent minimum
d. Reduction in area	15 percent minimum

Failure to meet these minimum acceptance criteria shall be cause for rejection of that quantity of detonator bodies.

3.3 TEST CONDITIONS

3.3.1 Test Program

The supplier shall establish a test program (detailed procedures) in accordance with the requirements of this specification.

3.3.2 Vibration Testing

Vibration testing shall be conducted per Shuttle environmental vibration spectrum requirements, listed in paragraphs 3.4.11 sections d and e, as specified in the Qualification Test and Lot Acceptance Test matrixes.

3.3.3 Test Chamber

Test chamber control instrumentation shall be accordance with MIL-STD-810D.

3.3.4 Temperature Stabilization

Temperature stabilization shall have been attained when the first and last of three 5 minute interval readings on one thermocouple junction mounted on the test specimen are within 2 degrees F of each other.

3.3.5 Test Article

All test articles shall be instrumented in a manner conducive to monitoring the largest internal mass of the test article for thermal stabilization and the operating temperature of critical components. Thermal sensor shall be located on the test article surfaces being irradiated and shall be thermally insulated from the radiation source.

3.3.5.1 Standard Test Conditions:

Pressure	28.5 +2/-4.5 inches of Hg
Temperature	73 +/- 18 degrees F
RH	50 +/- 30 percent

3.3.5.2 Dent Block Test Configuration

The dent block indentation fixture shall be in accordance with MIL-STD-331A (test 301.1). The sleeve shall be brass which complies with specification QQ-B-626D and shall have a bore of 0.055 inches minimum. A minimum quantity of silicone compound complying with specification MIL-S-8660 shall be applied to the dent block to assure intimate contact between the test sample and the steel block face.

3.4 PERFORMANCE

3.4.1 Environments

3.4.1.1 Flight Environments

The detonator shall perform as specified during and after exposure to any combination of the following environments. The criteria described below represent the spacecraft flight mission environmental conditions and levels to which the detonator will be subjected during the various flight mission phases.

a. Temperature: From -420°F to +200°F

b. Humidity: Relative humidity up to 95 (+/- 5) percent including condensation of water.

c. Pressure: 7.5×10^{-10} millimeters of mercury for 360 hours.

d. Random Vibration Levels: (Orbiter & SRB Envelope)

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TABLE I.-VIBRATION LEVELS

20 Hz @ 0.20 g2/Hz
20 - 40 Hz @ +3 dB/octave
40 - 60 Hz @ 0.40 g2/Hz
60 - 100 Hz @ +6 dB/octave
100 - 350 Hz @ 1.0 g2/Hz
350 - 600 Hz @ +6 dB/octave
600 - 1000 Hz @ 3.0 g2/Hz
1000 - 2000 Hz @ -7 dB/octave
2000 Hz @ .60 g2/Hz

Composite = 57.5 grms

Three Orthogonal Axes, with Duration of 6 minutes minimum per axis
(See figure 1 for Axes Orientation)

e. Random Vibration (External Tank)

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TABLE II.-VIBRATION LEVELS

LONGITUDINAL (X)	RADIAL (Z) and TANGENTIAL (Y)
20 Hz @ 0.0019 g2/Hz	20 Hz @ 0.1 g2/Hz
20 - 60 Hz @ +9 dB/Octave	20 - 60 Hz @ +6 dB/Octave
60 - 200 Hz @ 0.05 g2/Hz	60 - 335 Hz @ 0.9 g2/Hz
200 - 360 Hz @ -7 dB/Octave	335 - 500 Hz @ +6 dB/Octave
360 -2000 Hz @ 0.013 g2/Hz	500 -2000 Hz @ 2.0 g2/Hz
Composite = 5.75 grms	Composite = 59.14 grms

Three Orthogonal Axes, with Duration of 3 minutes minimum per axis
(See figure 1 for Axes Orientation)

Vibration Tolerances

Test tolerances shall be used as specified in MIL-STD-810D, or FED-STD-101B (2) as applicable, except as follows:

Random Vibration. Test tolerances for parameters associated with random vibration tests shall be as follows:

a. The tolerances on acceleration spectral density shall vary with analyzer filter bandwidth. The desired analysis system should provide more than 100 statistical degrees of freedom; however, in no case shall the analysis system provide less than 50 degrees of freedom. Tolerances on acceleration spectral density are as follows:

Spectrum Frequency Band, Hz	Normal Filter Bandwidth, Hz	Tolerances dB
10 to 100	10 or less	+3.0/-1.5
100 to 350	25 or less	+3.0/ -1.5
350 to 2000	50 or less	+3.0/ -1.5
	or	
10 to 100	5 or less	+4.5/ -1.5
100 to 350	10 or less	+4.5/ -1.5
350 to 2000	25 or less	+4.5/ -1.5

Note: Normal filter bandwidths are the difference in frequency as determined at the half-power points.

b. The tolerance on overall root-mean-square (rms.) acceleration shall be +15/-5 percent (for qualification tests) as measured by a true rms. voltmeter with a 2000 Hz cutoff filter of at least 12 dB per octave.

c. The tolerance on frequency shall be +/- 10 percent.

d. The tolerance on the duration shall be +10/-0 percent.

3.4.1.2 Safety Environments (auto-ignition)

The detonator shall not fire during exposure to a temperature of + 340 °F for one hour (The detonator may be rendered inoperative from this exposure).

3.4.2 Useful Life

The useful life of the detonator shall be 4 years minimum from the date of manufacture, with a maximum of 10 years based upon age life testing performed by NASA per NSTS 08060.

3.4.3 Ignition Capability

The detonator shall meet the performance requirements of this specification from +200 to -420 °F.

3.4.3.1 Detonator Failure Attributed to NSI

A detonator malfunction caused by an NSI failure to fire is not the liability of the contractor. A failure of the NSI would necessitate provisions for removal and replacement of the problem lot at the Governments expense. NASA/JSC shall perform the failure analysis on the NSI, during which the vendor may participate.

4.0 QUALITY ASSURANCE/RELIABILITY PROVISIONS

4.1 QUALITY ASSURANCE PROGRAM

The supplier shall have or establish a quality assurance program that conforms to the requirements of Specification NHB 5300.4 (ID-2).

4.2 RELIABILITY PROGRAM REQUIREMENTS

Reliability program requirements shall be in accordance with the NASA purchase order (contract) and specification NHB 5300.4 (ID-2).

4.3 TRACEABILITY

The supplier shall establish a traceability system in accordance with Specification NHB 5300.4 (ID-2). Each component part, and subassembly comprising or contained within the end item or major component shall be processed as traceable, in accordance with the criteria contained herein.

4.3.1 Serial Traceability (T/S)

Serial traceability requires the assignment of a unique serialized identifier and processing of each part, subassembly, major component, or end item identified (T/S) as a separate item, maintaining historical records pertaining to that item alone. The historical records in turn will provide the capability for backward traceability to the identification of its procurement, fabrication, inspection, processing, test and operating records and any other pertinent data deemed necessary by the seller. This capability shall also provide for backward traceability to the procurement document(s) and receiving record(s) of part(s), components, and subassemblies within the end item designated as traceable (exempt items excluded).

4.3.2 Lot Traceability (T/L)

Lot traceability requires lot serial numbering of sub/tier items produced by the lot, batch, mix heat, or melt in a given time sequence and the maintaining of historical data equally pertinent to all items in the lot. Separate lot numbers shall be assigned when planned differences between individual items in the lot occur due to changes in materials (substitution) or processes which affect form, fit, or function. The "given time sequence" includes identification of work on the production order for the specific part number, from initiation of work through completion of the last operation.

4.3.3 Member Traceability (T/M)

Member traceability requires both serial and lot traceability so that the items are controlled as members of a lot and also controlled as serialized items, and to maintain historical records pertaining to the individual item and to all items of the lot. The historical records shall provide backward traceability to the individual items serial and lot fabrication, inspection, processing and test records and any other pertinent data deemed necessary by the seller.

5.0 CLASSIFICATION OF TESTS

The tests specified herein shall be classified as follows:

a. Qualification

b. Acceptance

5.1 QUALIFICATION TESTS

Qualification test shall be conducted by new NSD contractors (contractors that have not fabricated flight NSDs before) to provide evidence that their production line can produce detonators that meet all the design and performance requirements listed within this specification. The contractor shall be considered a qualified NSD source after successfully fabricating and testing sixty (60) NSD assemblies that pass the test requirements listed in Table III without failure. The Qualification test can be used to accept a lot of NSDs for flight providing that the remaining units were fabricated from the same material lot and the total quantity tested represent 10 % of the lot. Additional units shall be tested at ambient to meet the 10 % DLAT requirement. Any deviation from the test procedure shall require the Contracting Officer's Technical Representative's (COTR) approval. All detonator assemblies shall have pass the non-destructive lot acceptance tests described in Table IV of this specification prior to being subjected to the qualification tests.

TABLE III.- QUALIFICATION TESTS

TEST PARA.	NAME OF TEST	QUANTITY GROUP A	GROUP B	GROUP C	GROUP D
5.1.1	Vibration and High Temp	25			
5.1.2	Vibration and Low Temp		25		
5.1.3	Temp Cycle and Leak Test	25	25		
5.1.4	Eight Foot Drop				6
5.1.5	High Temp Tolerance			4	
5.1.6	Plate Dent, Room Temp	10	10	4	6
5.1.7	Plate Dent, High Temp	5	5		
5.1.8	Plate Dent, Low Temp	5	5		
5.1.9	Plate Dent, Cryogenic Temp	5	5		

5.1.1 Vibration and High-Temperature Test

The detonator shall be installed in a test fixture and torqued to 150 +/-5 in/lbs. The test fixture shall be designed so that resonances in the fixture within the frequency spectrum specified for the test are minor. Connecting lines to the fixture for operation or data recording shall not amplify or dampen vibration inputs. The magnitude of the applied vibration shall be monitored on the test fixture near the detonator. Vibration of the detonator shall be recorded in the three mutually perpendicular axes. The test time shall be 6 minutes per axis in each of three mutually perpendicular axes, one of which shall be the axial centerline, with the detonator temperature stabilized at +200(+/- 5) °F.

The detonator shall be subjected to random vibration as shown by TABLE I Vibration Levels, in paragraph 3.4.1.1 d.

The random spectrum shall be equalized and analyzed.

The detonators will be x-rayed per paragraph 5.2.1.6 following vibration and examined for any movement of the explosive mix or components.

5.1.2 Vibration And Low-Temperature Test

The test procedure shall be the same as in paragraph 5.1.1 except that the detonator and test fixture shall be stabilized at a temperature of -65 (+ /-10) °F during the vibration test. The detonators will be x-rayed after vibration per paragraph 5.2.1.6 and examined for any movement of the explosive mix or components.

5.1.3 Temperature Cycling And Leak Test

The detonator shall be placed in an environmental test chamber and the detonator shall be subjected to seven temperature cycles of 48 hours per cycle. Each cycle shall consist of the following:

a. Twenty hours minimum at +200 (+/- 5) °F.

b. Four hours maximum transition from +200 to -260 °F.

c. Twenty hours minimum at -260 (+/- 5) °F.

d. Four hours maximum transition from -260 to +200 °F.
At the conclusion of the test, the detonators shall be visually inspected and evidence of deterioration shall be recorded. A Hermetic Seal Test shall be performed per paragraph 5.2.1.5.

5.1.4 Eight-Foot Drop Test (Off-Limit)

Three detonators shall be dropped 8 feet one each in the following positions:

a. Electrical connector upward

b. Electrical connector downward

c. Cartridge horizontal

This test shall be similar to the drop test specified Standard MIL-STD-331A except for the height of drop. A new detonator shall be used for each drop. No detonator shall fire as a result of the drop. After being dropped, each detonator shall be fired in accordance with 5.1.6 for information purposes only.

5.1.5 High Temperature Tolerance Test (Off-Limit)

Four detonators shall be placed in a preheated temperature chamber at 340 (+/-5) °F, the detonator shall remain at the designated temperature for three hours or until auto-ignition, whichever occurs first. If a detonator auto-ignites, the test shall be stopped. If auto-ignition occurs before three hours, the time of auto-ignition shall be recorded. If no auto-ignition occurs the detonators shall be fired in accordance with paragraph 5.1.6.

The high temperature tolerance shall have been considered as established by a one-hour test requirement. Failure to fire after high temperature exposure (340 °F) does not disqualify the detonator lot. Dent block penetration is for Engineering information only.

5.1.6 All-Fire Current Tests, Dent Plate, Room Temperature

The dent plate penetration shall be a minimum of 0.040 inches.

5.1.7 All-Fire Current Tests, Dent Plate, High Temperature

The test procedure shall be the same as in paragraph 5.1.6 except that the detonator and test fixture shall be stabilized, at a temperature of +200 (+/-5) °F and fired while at this temperature. Dent block penetration shall be a minimum of 0.040 inches.

5.1.8 All-Fire Current Tests, Dent Plate, Low Temperature

The test procedure shall be the same as in paragraph 5.1.6 except that the detonator and dent block shall be stabilized for 30 minutes at a temperature of -260 (+5/ -5) °F and fired while at this temperature. Dent block penetration shall be 0.030 minimum.

5.1.9 All-Fire Current Tests, Dent Plate, Cryogenic Temperature

The test procedure shall be the same as in paragraph 5.1.6 except that the detonator and dent block shall be conditioned to -420 +/- 10 °F. Temperature stabilization per para 3.3.4 is not required. Dent block penetration shall be 0.020 minimum.

NOTE: THIS TEST WILL BE PERFORMED BY NASA AT JSC (at no cost to the vendor).

5.2 LOT ACCEPTANCE TESTS

Prior to delivery and as a condition of lot acceptance, the qualified contractor shall perform both nondestructive and destructive lot acceptance tests on each production lot of NSDs.

The non-destructive acceptance tests listed in Table IV, shall be performed on each detonator in the lot. Any detonator found to possess a defect shall be rejected. The contractor shall correct all deficiencies; if possible, and shall present documented evidence of rework and corrective action to the (COTR) prior to resubmitting reworked detonators for acceptance testing. Individual units that fail to comply with NSD Assembly Drawing SEB26100094 and/or NSD specification SKB26100097 after rework shall be scrapped. Failure of an individual unit during non-destructive acceptance tests does not automatically cause the entire lot to fail.

Destructive lot acceptance tests shall be according to paragraph 5.2.2. During lot acceptance firings, the failure of any detonator to meet the output requirements of this specification shall be cause for rejection of the entire lot of NSDs. Failures caused by NSIs installed in NSD does not cause the detonator lot to be rejected; however, the lot of NSIs shall be rejected, downgraded, and removed from the detonators prior to test continuation.

5.2.1 Non-destructive Acceptance Tests

TABLE IV Non-destructive Acceptance Tests (ALL DETONATORS)

Test Paragraph	Name of Test
5.2.1.1	NSI Flight Certification & -420 °F Verification Test
5.2.1.2	Staking Verification
5.2.1.3	Tensile Test Coupon Performance Verification
5.2.1.4	Bridgewire Resistance
5.2.1.5	Hermetic Seal (Leak Test)
5.2.1.6	Radiographic Examination (x-ray)
5.2.1.7	Neutron Radiography
5.2.1.8	Insulation Resistance (50 volt dc) Test
5.2.1.9	Examination of product

NOTE: Sequence of testing, paragraphs 5.2.1.4 through 5.2.1.8, may be conducted in any order; examination of product paragraph 5.2.1.9 shall be performed last.

5.2.1.1 NSI Flight Certification Verification

Verify that all NSI's (NASA Standard Initiators) utilized in the lot of detonators are listed by serial and lot number in the NASA Flight Certification Document accompanying the shipment. Also, verify that the respective NSI lot has successfully completed -420 °F Certification Testing.

5.2.1.2 Staking Verification

Verify that the NSI (NASA Standard Initiator) data pack contains documentary evidence that the NSI staking conforms to NASA JSC drawing SEB26100001 and the NSI meets the configuration requirements of SEB26100094.

5.2.1.3 Tensile Test Coupon Performance Verification

Verify that the NSD data pack contains documentary evidence that tensile test coupon were properly obtained and tested to NASA JSC drawing SEB26100094 requirements.

5.2.1.4 Bridgewire Resistance Test

The bridgewire resistance of each NSI/NSD shall be measured and recorded on the test data sheet. The measured resistance shall be 1.05 (+/- 0.10) ohms at laboratory ambient temperature.

5.2.1.5 Hermetic Seal (Leak Test)

The detonator shall be subjected to a pressure of 25 millimeters of mercury maximum (absolute pressure) for 5 minutes minimum and then to helium at a pressure of two atmospheres minimum for a minimum of 45 minutes after which a one atmosphere helium environment may be maintained. The leak rate measurement shall be made within 20 minutes after removal from the helium environment and shall be recorded on the test data sheet. Leakage shall not exceed 1×10^{-6} scc per second of helium. Procedures for testing shall be submitted to NASA for approval prior to testing.

5.2.1.6 X-Ray Test

All detonators shall be X-rayed along the longitudinal axis, to verify compliance to the assembly drawing. The detonators shall be X-rayed in serial number sequence and the test data serialized. Radiography shall be performed in accordance with MIL-STD-453B. The detonator shall satisfactorily conform to the following criteria to successfully pass the acceptance radiographic test.

a. Verify that the lead azide charge is present, properly oriented and free of voids, cracks, or discontinuities. (RDX charge does not show on the X-ray.)

b. Determine that there are no missing or improperly oriented parts.

c. Determine that there are no foreign objects or materials present.

d. Verify that the lot, serial, and part numbers are on the radiographs.

e. A set of acceptable X-ray negatives of the detonators shall be submitted to the COTR as part of documented final inspection records required by DRD. These negatives shall be sent to NASA-JSC, EP5, (reference DRD RA-466T-C) 2 weeks prior to Lot Acceptance Review.

5.2.1.7 Neutron Radiography Test

All detonators shall be subjected to neutron radiography (Reactor Radiation Source) examination in one view in accordance with JSC 20431 to verify compliance with the assembly drawing. The detonators shall satisfactorily conform to the following criteria to successfully pass the neutron radiographic test.

a. Verify that the RDX charge is present and properly oriented and that there are no voids, cracks, or discontinuities (Lead azide charge will not be visible on the N-ray).

b. Verify that there are no missing or improperly oriented parts.

c. Verify that there are no foreign objects or materials present.

d. One original neutron radiograph negative of the detonator shall be submitted to the COTR as part of documented final inspection records required by DRD. These negatives shall be sent to NASA-JSC, EP5, (reference DRD RA-467T-C) 2 weeks prior to the Lot Acceptance Review.

e. Verify that the lot, serial, and part numbers are on the radiographs.

5.2.1.8 Insulation Resistance (50 volt dc) Test

The resistance between the detonator body assembly and NSI pins shorted together shall be measured and recorded on the test data sheet for each detonator by applying a potential of 50 volts direct current maximum for at least 60 (+/- 5) seconds between shorted pins and the body assembly. The measured resistance shall not be less than 2 megohms.

5.2.1.9 Examination of Product

The detonator shall be inspected to verify that the material, design, construction, necessary dimensional characteristics, markings, and workmanship comply with the requirements of this specification. Examine accompanying data for each detonator to verify that the weight difference, without pyrotechnic mixture and with pyrotechnic mixture, is within the tolerance variation specified in data package. Conduct a GO, NO-GO thread check with thread gauge.

5.2.2 Destructive Lot Acceptance Tests

5.2.2.1 Vibration and Low Temperature Test (-80 °F)

The detonator shall be installed in a test fixture and torqued to 150 in-lbs. The test fixture shall be designed so that resonances in the fixture within the frequency spectrum specified for the test are minor. Connecting lines to the fixture for operation or data recording shall not amplify or dampen vibration inputs. The magnitude of the applied vibration shall be monitored on the test fixture near the detonator. Vibration of the detonator shall be recorded in the three mutually perpendicular axes. The test time shall be 3 minutes per axis in each of three mutually perpendicular axes, one of which shall be the axial centerline, with the detonator temperature stabilized at -80 (+/- 5) °F.

The detonator shall be subjected to random vibration levels (External Tank) as shown by TABLE II Vibration Levels, in paragraph 3.4.1.1 e.

The random spectrum shall be equalized and analyzed.

The detonators will be x-rayed per paragraph 5.2.1.6 and N-rayed per 5.2.1.7 following vibration and examined for any movement of the explosive mix or components.

5.2.2.2 Insulation Resistance (250 volt dc) Test

The resistance between the detonator body assembly and initiator pins shorted together shall be measured and by applying a potential of 250 (+/- 5%) volts direct current for at least 15 seconds minimum between shorted NSI pins and the body assembly. The measured resistance shall be recorded on the test data sheet for each detonator used in DLAT, and shall not be less than 2 megohms.

5.2.2.3 Firing Lot Sample

A random sample of detonators from lots that have passed the nondestructive tests described in Table IV shall be vibrated and/or fired as specified in Table V. Failure of the detonator to produce minimum plate dent shall be cause for rejection of the entire lot of detonators. The number of detonators to be fired from each lot shall be as follows:

Lot Size*	Sample Size**
100 - 1500	10% of quantity

* Lot size equals the number of units presented for LAT, Para. 5.2.1

** Fractional sample size below 0.5 shall be rounded downward.

** Fractional sample size 0.5 and above shall be round upward.

TABLE V - LOT SAMPLE TEST QUANTITY

Spec. Paragraph	Name of Test	% of Total lot Size
5.2.2.1	Vibration/Low -Temp. (-80 °F)	10 %
5.2.2.2	Insulation Resistance (250 Vdc)	10 %
5.2.1.6	X-Ray	10 %
5.2.1.7	N-Ray	10 %
5.1.6	Ambient Firings	2 %
5.1.7	High Temp. Firings (+200 °F)	2 %
5.1.8	Orbiter Low Temp. Firings (-260 °F)	3 %
5.1.9	Cryo Temp. Firings (-420 °F)	3 %

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5.2.2.3.1 Internal Detonator Pressure

The detonator body shall not be fractured except for the portion immediately surrounding the main charge when the detonator is fired. (Failure of the GFE initiator body or threads does not constitute a detonator failure)

5.2.2.3.2 Faraday Caps

The Faraday Caps furnished with the NSI are reusable. Those caps removed from the lot sample firing specimens shall be returned to NASA JSC.

5.3 PREPARATION FOR DELIVERY

Shipping, preservation and packaging shall be in accordance with section 7.0 of the statement of work for the procurement of the NSD.

6.0 NOTES

6.1 Definition

The following definitions are intended to clarify the meaning of certain terms used in this specification.

6.1.2 Date of Manufacture

The date (month and year) of satisfactory completion of all the required manufacturing and inspection processes prior to submittal of the lot for acceptance tests.

6.1.3 Qualification Tests

Qualification Tests are tests to demonstrate the production hardware performance in accordance with the design specification within the design limit conditions and under a simulation of normal mission conditions.

6.1.4 Lot

A lot shall consist of all detonators submitted for acceptance testing at one time that have been fabricated (left and right hand threaded bodies may be fabricated separately), assembled, and loaded under one contract in one unchanged manufacturing process. Left and right hand threaded detonators may be included in a single lot. Explosive materials used shall be from one batch and loaded in one continuous process. When a lot consists of detonators with left and right hand threads, a common lot designation can be used on all units of the lot even though different dash numbers (-201 or -202) exist within the lot. NASA, however, may choose that separate lot identifiers be used for the two configurations (-201 and - 202) made under one contract.

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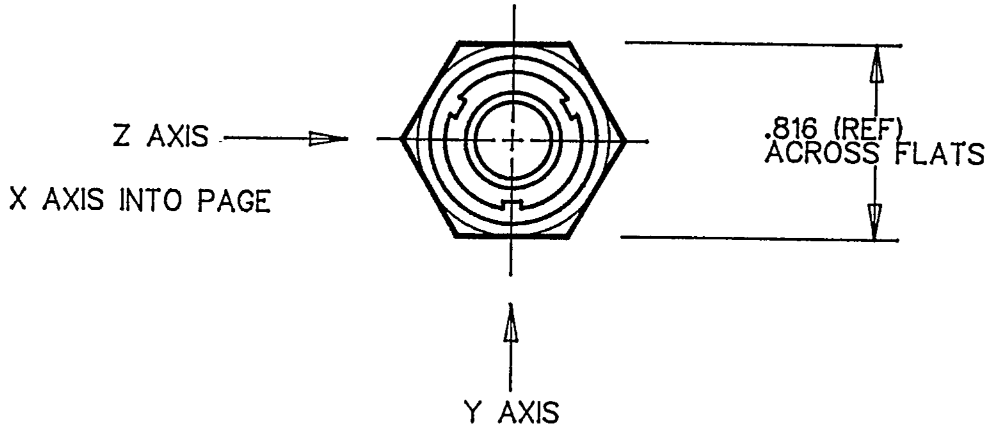

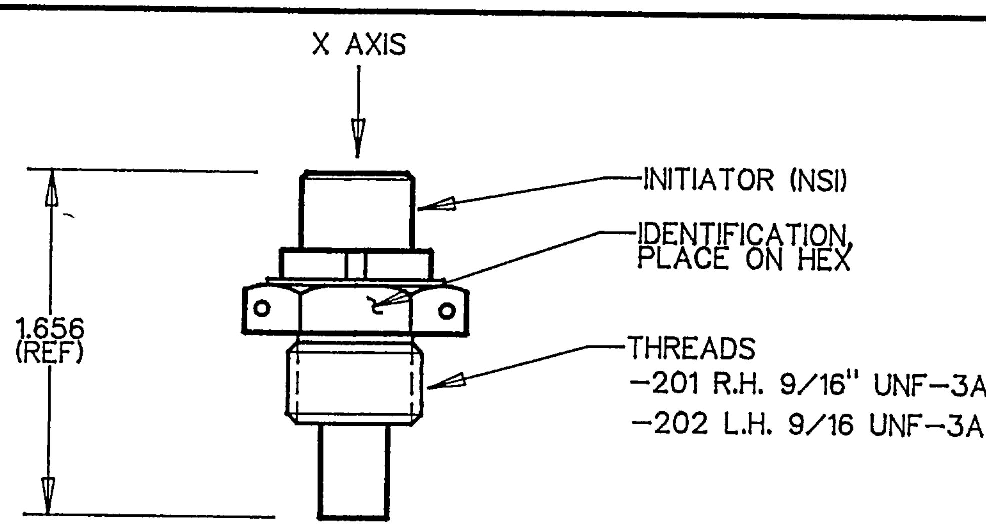

HEXAGON IDENTIFICATION

(1) VENDOR CODE (2) SERIAL NUMBER (3) LOT DESIGNATION *

(4) NASA PART NUMBER SEB26100094–20X ** (5) DATE OF MANUFACTURING

*NOTE: LOT DESIGNATOR SHALL BE SUPPLIED BY THE CONTRACTING OFFICER'S TECHNICAL REPRESENTATIVE AND/OR CONTRACTING OFFICER.

** –201 OR 202 WHICHEVER IS BEING MANUFACTURED.

FIGURE 1

AXIS ORIENTATION AND MARKING OF NSD